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In re

Patent Application of

David Anthony Harries, et al.

Application No. Unknown

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Filed: November 18, 2003

Examiner: Unknown

"GEAR ENGAGEMENT MECHANISMS"

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Sir:

Enclosed is the priority document for the United Kingdom Application No. 0226934.8, filed November 19, 2002, from which the above-identified U. S. patent application claims priority.

Respectfully submitted,

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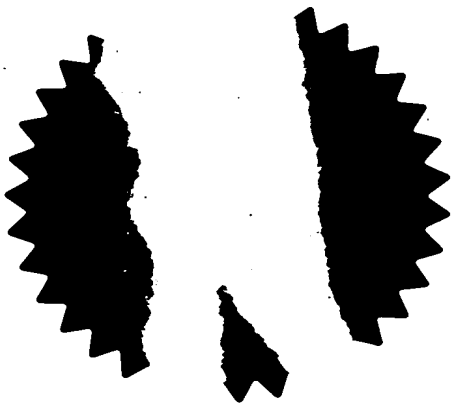

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2.	Patent application number *(The Patent Office will fill in this part)*	0226934.8 — 19 NOV 2002
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	LuK Lamellen und Kupplungsbau Beteiligungs K Industriestrasse 3 D-77815 Buhl Baden
	Patents ADP number *(if you know it)*	8151904001
	If the applicant is a corporate body, give the country/state of its incorporation	Germany
4.	Title of the invention	GEAR ENGAGEMENT MECHANISM
5.	Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Anthony Cundy & Co. 1 Olton Bridge 245 Warwick Road Solihull B92 9AH
	Patents ADP number *(if you know it)*	00002188001 ✓
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country / Priority application number *(if you know it)* / Date of filing *(day / month / year)*
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DUPLICATE

GEAR ENGAGEMENT MECHANISM

The present invention relates to a gear engagement mechanism and in particular a gear engagement mechanism for an automatic or semi-automatic transmission system, including a multi-ratio gearbox in which gear ratios are engaged using actuators under the control of an electronic control unit.

Hitherto, automatic or semi-automatic transmission systems of this type, for example as disclosed in WO97/05410 or WO97/40300, whose content is expressly incorporated in the disclosure content of the present application, have utilised a conventional gear selection mechanism, as used with a manual gearbox, movement of the selector means being controlled by a pair of double-acting actuators to control movement of the selector means in a first direction to select a pair of gear ratios and in a second direction to engage one of the selected pair of gear ratios.

An object of the invention is to provide a gear engagement mechanism, for use in an automatic or semi-automatic transmission system, of simplified construction and operation.

According to one aspect of the present invention a gear engagement mechanism comprises a first and a second shift rail, each shift rail being adapted to control engagement of one of a pair of gears by axial movement of the shift rail in one direction or the other, a first and a second shift finger, the first and second shift fingers being mounted for rotation in a plane parallel to the axis of the first and second shift rails respectively, by which the shift rails may be moved axially in either direction, the first shift finger being mounted for rotation with a drive shaft, said first shift finger being mounted on the drive shaft for pivotal movement in a

plane parallel to the axis of the drive shaft, between a disengaged position in which it is clear of first shift rail and an engaged position in which it engages the first shift rail, the second shift finger being formed as a bell crank lever, the bell crank lever having a first limb which permanently engages the second shift rail and a second limb, the first shift finger being engagable with the first shift rail or with the second limb of the bell crank lever, depending on the angular orientation of the first shift finger; and means being provided to move the first shift finger between its engaged and disengaged positions.

With the gear engagement mechanism disclosed above the first shift finger may be engaged with the first shift rail, so that rotation of the first shift finger by means of the drive shaft will cause axial movement of the first shift rail in either direction, depending on the direction of rotation of the drive shaft. Alternatively the first shift finger may be engaged with the second limb of the bell crank lever, so that rotation of the first shift finger will cause the bell crank lever to rotate, moving the second shift rail axially.

The above mechanism may be adapted to operate three or more shift rails, a further bell crank lever being provided for each additional shift rail. The second limbs of each additional bell crank lever being spaced angularly of the second limbs of the other bell crank levers.

According to a further embodiment of the invention a brake mechanism for a rotary drive comprises a rotor, the rotor having a plurality of fingers, the fingers being spaced angularly of one another and having a resilient radially extending portions and axially extending portions spaced radially of the axis of the rotor, masses being secured to the axially extending portions of the fingers; and a stator, the stator having an annular plug formation disposed coaxially of the rotor, the axially extending portions of the rotor or the masses secured thereto, frictionally engaging an external diameter of the plug formation when the rotor is stationary, the frictional engagement between the stator and rotor when the speed of the

rotor reaches a threshold value reducing to zero due to centrifugal loading of the masses.

The invention is now described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 illustrates diagrammatically a gearbox of a motor vehicle;

Figure 2 illustrates a gear engagement mechanism for the gearbox illustrated in Figure 1, in accordance with the present invention;

Figure 3 is an end elevation of gear selector of the engagement mechanism illustrated in Figure 2;

Figure 4 is side elevation of the gear sector of the mechanism illustrated in Figure 3, in the direction of arrow IV;

Figure 5 side elevation of the gear sector of the mechanism illustrated in Figure 3, in the direction of arrow V;

Figure 6 is a partial sectional elevation of the gear engagement mechanism illustrated in Figure 2 ;

Figure 7 is a sectional side elevation, along the line VII – VII of Figure 8, illustrating a modification to the gear engagement mechanism shown in Figure 2;

Figure 8 shows an end elevation of the modification illustrated in Figure 7; and

Figure 9 is a part sectional view along the line IX – IX of Figure 7.

In the transmission system illustrated in Figure 1 a clutch 14, when engaged, transmits torque between the output shaft of engine 10 and an input shaft 20 of a gearbox 12. Engagement of clutch 14 is controlled by clutch slave cylinder 16 in conventional manner.

Input shaft 20 has six gears 22,23,24,25,26 and 27 mounted thereon for rotation therewith. Gears 22,23,24,25 and 26 mesh with gears 32,33,34,35 and 36 respectively and gear 27 meshes with gear 37, via an intermediate gear 38. The gears 32,33,34,35,36 and 37 are mounted on a lay shaft 40, which is mounted parallel to but spaced from input shaft 20. Gears 32,33,34,35,36 and 37 are mounted on lay shaft 40 for rotation relative thereto. Gears 32 and 37 are selectively engaged for rotation with lay shaft 40 by means of a synchromesh unit 42; gears 33 and 34 are selectively engaged for rotation with lay shaft 40 by means of a synchromesh unit 44; and gears 35 and 36 are selectively engaged for rotation with lay shaft 40 by means of a synchromesh unit 46.

The gears 22 and 32 are sized to provide a first gear ratio; gears 23 and 33 a second gear ratio; gears 24 and 34 a third gear ratio; gears 25 and 35 a fourth gear ratio; and gears 26 and 36 a fifth gear ratio; while intermediate gear 38 reverses the direction of rotation so that gears 27 and 37 provide a reverse gear ratio.

The lay shaft 40 is drivingly connected to an output shaft 50 from the gearbox12, via gears 39 and 52.

The synchromesh units 42,44 and 46 are controlled by shift rails 70,72 and 74 respectively, axial movement of the shift rails 70,72 and 74 moving the

synchromesh units 42,44 and 46 axially of the lay shaft 40. In this manner synchromesh unit 42 (as illustrated in figure 1) may be moved to the left, to engage gear 37 with layshaft 40, thereby engaging reverse gear; or to the right to engage gear 32 with lay shaft 40 thereby engaging first gear. Synchromesh unit 44 may be moved to the left to engage gear 33 with layshaft 40, to engage second gear; or the right to engage gear 34 with lay shaft 40, to engage third gear. Synchromesh unit 46 may be moved to the left to engage gear 35 with lay shaft 40, to engage fourth gear; or the right to engage gear 36 with lay shaft 40, to engage fifth gear.

As illustrated in figure 1, each of the shift rails 70,72 and 74 has a notch 76, the notches 76 in the shift rails 70,72 and 74 being aligned transversely of the shift rails 70,72 and 74, when the synchromesh units 42,44 and 46 are in a central, neutral position, in which neither gear 32,37; 33,34; or 35,36 associated with each respective synchromesh unit 42,44 and 46 is engaged with the lay shaft 40.

The notches 76 in shift rails 70,72,74 are engaged by a shift fingers 102,104,106 of a gear engagement mechanism 100 respectively, as illustrated in greater detail in figures 2 to 6. The shift fingers 102,104,106 are mounted on a drive shaft 110, which is drivingly connected to an electric motor 112 by means of gear train 114,116 and reduction gear box 118.

Shift finger 102 is pivotally mounted to a hub formation 120 on the drive shaft 110, by means of pivot pin 122, the axis of which is transverse to the axis of the drive shaft 110. The shift finger 102 is located in a diametrical slot 124 in the hub formation 120, the drive shaft 110 passing through an elongate aperture 126 in the shift finger 102, so that the shift finger 102 may be pivoted between a disengaged position in which it will be clear of the notch 76 in shift rail 70, as illustrated in figure 6, and an engaged position in which it is disposed vertically and will engage the notch 76 in shift rail 70.

A push rod 130 is located in a closed axial bore 132 in drive shaft 110, a solenoid actuator 134 being located at the open end of bore 132, acting on the push rod 130 to move it axially of the drive shaft 110 against the load applied by a return spring 136 which acts between the closed end if bore 132 and the adjacent end of push rod 130. The solenoid actuator 134 also has a return spring 140 which acts on a solenoid plunger 142 to return the plunger to the right, as illustrated in figure 6, when the solenoid actuator is de-energised. The push rod 130 is connected to shift finger 102 by means of pivot pin 144, which extend transversely of the drive shaft 110 through an axially extending diametrical slot 146. Axial movement of push rod 130 will thereby pivot the shift finger 102 between its disengaged and engaged positions.

The shift finger 104 is rotatably mounted on drive shaft 110 by means of a bearing formation 150 and shift finger 106 is rotatably mounted on the external diameter of bearing formation 150. A pin 152 locates the shift fingers 104,106 axially adjacent the hub formation 120.

The shift fingers 104.106 which permanently engage notches 76 in shift rails 72 and 74 respectively, are each defined by one limb of a bell crank lever 154,156. The other limbs 158,160 of the bell crank levers 154,156 each define an axially extending slot 162, the slots 162 being of similar dimensions to the notch 76 in shift rail 70. Limb 158 of bell crank lever 154 is disposed 120^0 clockwise from shift finger 104 and limb 160 of bell crank lever 156 is disposed 240^0 clockwise from shift finger 106, so that the slots 162 on bell crank levers 154 and 156 and the notch 76 on shift rail 70, when in its neutral position, will be spaced angularly at 120^0 intervals. The slotted portions of bell crank levers 154 and 156 are also offset axially from shift fingers 104 and 106, so that the slots 162 are aligned axially with the notch 76 in shift rail 70.

A guide plate 170 is located in fixed axial and rotational position between the engaged and disengaged positions of shift finger 102. The guide plate 170 has apertures 172 at angularly spaced positions corresponding to the positions of notch 76 on shift rail 70, and slots 162, when shift fingers 102.104 and 106 are in there neutral positions. The apertures 172 are shaped to permit the shift finger 102 the move between its engaged and disengaged positions, only when it is accurately aligned with the notch 76 in shift rail 70 or one of the slots 162 in bell crank levers 154 or 156.

With the mechanism described above shift finger 102, in its disengaged position, may be rotated by motor 112 until it is aligned angularly with the notch 76 in shift rail 70. The shift finger 102 may then be moved by solenoid actuator 134, into engagement with notch 76 on shift rail 70. Rotation of shift finger 102 by motor 112, in either direction, will then move shift rail 70 axially to actuate synchromesh unit 42 and engage either the 1st or reverse gear.

To control synchromesh unit 44 the engage either 2nd or 3rd gear, the shift finger 102, in its disengaged position, is rotated by motor 112 until it is aligned angularly with the slot 162 in bell crank lever 154. Solenoid actuator 134 is then energised to move shift finger 102 into engagement with the slot 162 in bell crank lever 154. Rotation of shift finger 102 by motor 112 will then cause bell crank lever 154 to rotate, causing the shift finger 104 to move shift rail 72.

In similar manner, shift finger 102 may be engaged with slot 162 in bell crank lever 156 to cause movement of shift finger 106 and shift rail 74 engaged thereby, to control synchromesh unit 46 and engagement of 4th and 5th gears.

Engagement of the various gears may be maintained, in conventional manner, by means of detents built into the gear box. Alternatively the electric motor 112 may be used to hold the gear in engagement. However, in order to prevent wind back

of the electric motor 112, it may be necessary to apply a continuous current to the motor 112 while the gear is engaged.

According to a further embodiment of the invention, the need for continuously powering the motor 112 may be avoided by providing a brake mechanism 180 in the drive between the motor 112 and the gear engagement mechanism 100, as illustrated in figures 7 to 9.

As illustrated in figures 7 to 9 the brake mechanism 180 having a rotor 182 comprising a series of masses in the form of steel ball 184 which are mounted on resilient fingers 186, the fingers 186 extending in angularly spaced relationship from a hub 188 mounted for rotation with the drive shaft 110. The fingers 186 are made of spring steel or similar resilient material. The fingers 186 have a radially extending portion 190 and an axially extending U-shaped portion 192. Apertures 194 are provided in the limbs of the U-shaped portion 192, for engagement of the steel balls 184, the steel balls 184 protruding through the apertures 194 to securely locate the steel balls 184.

A stator 200 has a static annular plug formation 202 which surrounds the drive shaft 110 and is located coaxially of the rotor, radially inside the U-shaped portions 192 of the fingers 186. The plug formation 202 has a shallow circumferential groove 204, the groove 204 being of arcuate section and, when the rotor 182 is stationary, being resiliently engaged by the portions of the steel balls 184 protruding through the apertures 194 in the inner limbs of the U-shaped portions 192 of fingers 186.

When the drive shaft 110 and rotor 182 are stationary, the frictional engagement between the steel balls 184 and plug formation 202 will be sufficient to prevent wind back of the electric motor 112 and will hold the selected gear in the engaged position. However when the motor 112 is energised to drive shaft 112, the centrifugal effect acting on the steel balls 184 will cause them to move outwardly,

this being permitted by the resilience of the fingers 186. The frictional engagement between the rotor 182 and stator 200 will thereby diminish as the speed of the motor 112 increases and may be tuned to reduce to zero at a predetermined speed.

While the brake mechanism 180 described with reference to figures 7 to 9 may be used with the gear engagement mechanism described with reference to figures 1 to 6, it may also be used for rotary drives of other gear engagement mechanisms or other mechanisms, for example motor driven clutch actuators.

While in the above embodiment steel balls are used, other forms of mass may be used. These masses may be secured to resilient fingers of the rotor in any suitable manner which will allow the masses to move outwardly when subject to centrifugal forces.

The patent claims submitted with the application are proposed formulations without prejudice to the achievement of further patent protection. The applicant reserves the right to submit claims for further combinations of characteristics, previously only disclosed in the description and/or drawings.

References back used in sub-claims refer to the further development of the subject of the main claim by the characteristics of the respective sub-claim; they are not to be understood as a waiver with regard to achieving independent item protection for the combination of characteristics in the related sub-claims.

Since the subject of the sub-claims can form separate and independent inventions with reference to the prior art on the priority date, the applicant reserves the right to make them the subject of independent claims or of division declarations. Furthermore, they may also contain independent inventions,

which demonstrate a design, which is independent of one of the objects of the preceding sub-claims.

The embodiments are not to be considered a restriction of the invention. Rather, a wide range of amendments and modifications is possible within the scope of the current disclosure, especially those variations, elements and combinations and/or materials which, for example, the expert can learn by combining individual ones together with those in the general description and embodiments in addition to characteristics and/or elements or process stages described in the claims and contained in the drawings with the aim of solving a task thus leading to a new object or new process stages or sequences of process stages via combinable characteristics, even where they concern manufacturing, testing and work processes.

Claims

1. A gear engagement mechanism (100) comprising a first and a second shift rail (70,72), each shift rail (70,72) being adapted to control engagement of one of a pair of gears (37,32,33,34) by axial movement of the shift rail (70,72) in one direction or the other, a first and a second shift finger (102,104), the first and second shift fingers being mounted for rotation in a plane parallel to the axis of the first and second shift rails (70,72) respectively, by which the shift rails (70,72) may be moved axially in either direction, characterised in that the first shift finger (102) is mounted for rotation with a drive shaft (110), said first shift finger (102) being mounted on the drive shaft (110) for pivotal movement in a plane parallel to the axis of the drive shaft (110), between a disengaged position in which it is clear of first shift rail (70) and an engaged position in which it engages the first shift rail (70), the second shift finger (104) being formed as a bell crank lever (154), the bell crank lever (154) having a first limb which permanently engages the second shift rail (72) and a second limb, the first shift finger (102) being engagable with the first shift rail (70) or with the second limb of the bell crank lever (154), depending on the angular orientation of the first shift finger (102); and means (134) being provided to move the first shift finger (102) between its engaged and disengaged positions.

2. A gear engagement mechanism (100) according to claim 1 characterised in that the mechanism includes three or more shift rails (70,72,74), an additional bell crank lever (156) being provided for each additional shift rail (74), the first limb of each additional bell crank lever (156) permanently engaging the additional shift rail (74) associated therewith and the second limb of each bell crank lever (154,156) being spaced angularly of the second limbs of the other bell crank levers (156,154), when the shift rails (72,74) associated therewith are in a neutral position.

3. A gear engagement mechanism (100) according to claim 1 or 2 characterised in that the second limbs of each of the bell crank levers (154,156) have slots (162) for engagement by the first shift finger (102), when in its engaged position, said slots (162) extending axially of the drive shaft (110), so that when engaged by the first shift finger (102), rotation of the first shift finger (102) will rotate the bell crank lever (154,156).

4. A gear engagement mechanism (100) according to claim 3 characterised in that a guide plate (170) is located in fixed axial and rotational position between the engaged and disengaged positions of the first shift finger (102), the guide plate (170) having apertures (172) shaped to permit the first shift finger (102) to move between its disengaged and engaged positions, only when the first shift finger (102) is accurately aligned with a notch (76) in the first shift rail (70) or with a slot (162) in one of the bell crank levers (154,156).

5. A gear engagement mechanism (100) according to any one of the preceding claims in which a hub formation (120) is provided on the drive shaft (110) for rotation therewith, the hub formation (120) having an axially extending diametrical slot (124), the first shift finger (102) being mounted in the diametrical slot (124) for pivotal movement about a pivot pin (122), the axis of the pivot pin (122) being transverse to the axis of the drive shaft (110), the drive shaft (110) passing through an elongate aperture (126) in the first shift finger (102), a push rod (130) being connected to the first shift finger (102), for movement of the first shift finger between its engaged and disengaged positions and means (134) being provided for moving the push rod (130).

6. A gear engagement mechanism (100) according to any one of the preceding claims characterised in that the first shift finger is moved between its disengaged and engaged positions by means of a solenoid actuator (134).

7. A gear engagement mechanism (100) according to claim 6 characterised in that the solenoid actuator (134) is mounted coaxially of the drive shaft (110).

8. A gear engagement mechanism (100) according to claim 7 characterised in that the push rod (130) is mounted in an axial bore (132) in the drive shaft (110), an inner end of the push rod (130) being pivotally connected to the first shift finger (102) by means of a pivot pin (144), the pivot pin (144) extending transverse to the axis of the drive shaft (110) through an axially extending diametrical slot (146).

9. A gear engagement mechanism (100) according to any one of claims 1 to 8 characterised in that the first shift finger (102) is biased towards its disengaged position.

10. A gear engagement mechanism (100) according to any one of the preceding claims characterised in that the drive shaft is driven by an electric motor (112).

11. A gear engagement mechanism (100) according to claim 10 characterised in that the electric motor (112) is connected to the drive shaft via a gear train (114,116) and/or a reduction gearbox (118).

12. A gear engagement mechanism (100) according to any one of the preceding claims characterised in that a brake (180) acts upon the drive shaft (110) to prevent rotation of the drive shaft (110) when no torque is applied to the drive shaft (110).

13. A gear engagement mechanism (100) according to claim 12 characterised in that the brake (180) comprises a rotor (182), the rotor having a plurality of fingers (186), the fingers (186) being spaced angularly of one another and having a resilient radially extending portion (190) and an axially extending portion (192) spaced radially of the axis of the rotor, masses (184) being secured to the axially extending portions (192) of the fingers (186); and a stator (200), the stator (200)

having an annular plug formation (202) disposed coaxially of the rotor (182), the axially extending portions (192) of the rotor (182) or the masses (184) secured thereto, frictionally engaging an external diameter (204) of the plug formation (202) when the rotor (182) is stationary, the frictional engagement between the stator (200) and rotor (182) when the speed of the rotor ((182) reaches a threshold value reducing to zero due to centrifugal loading of the masses (184).

14. A brake mechanism (180) for a rotary drive comprising a rotor (182), the rotor having a plurality of fingers (186), the fingers (186) being spaced angularly of one another and having a resilient radially extending portion (190) and an axially extending portion (192) spaced radially of the axis of the rotor, masses (184) being secured to the axially extending portions (192) of the fingers (186); and a stator (200), the stator (200) having an annular plug formation (202) disposed coaxially of the rotor (182), the axially extending portions (192) of the rotor (182) or the masses (184) secured thereto, frictionally engaging an external diameter (204) of the plug formation (202) when the rotor (182) is stationary, the frictional engagement between the stator (200) and rotor (182) when the speed of the rotor ((182) reaches a threshold value reducing to zero due to centrifugal loading of the masses (184).

15. A mechanism according to claim 13 or 14 characterised in that the axially extending portions (192) of the fingers (186) are U-shaped, apertures (194) being provided in the inner and outer limbs of the U-shaped portions (192), steel balls (184) engaging the apertures (194) to securely locate the steel balls (184).

16. A mechanism according to claim 15 characterised in that the steel balls (184) protrude through the apertures (194) in the inner limbs of U-shaped portions (192), a shallow arcuate circumferential groove (204) being provided in the stator (200), the groove (204) being frictionally engaged by the steel balls (184) when the rotor (182) is stationary.

17. A gear engagement mechanism (100) substantially as disclosed herein with reference to and as shown in figures 1 to 9 of the accompanying drawings.

18. A brake mechanism (180) substantially as disclosed herein with reference to and as shown in figures 7 to 9 of the accompanying drawings.

Abstract.

A gear engagement mechanism (100) includes a first and a second shift rail (70,72), each shift rail (70,72) being adapted to control engagement of one of a pair of gears (37,32,33,34) by axial movement of the shift rail (70,72) in one direction or the other. A first and a second shift finger (102,104) are mounted for rotation in a plane parallel to the axis of the first and second shift rails (70,72) respectively, by which the shift rails (70,72) may be moved axially in either direction by rotation of the shift finger (102,104). The first shift finger (102) is mounted for rotation with a drive shaft (110), the first shift finger (102) being mounted on the drive shaft (110) for pivotal movement in a plane parallel to the axis of the drive shaft (110), between a disengaged position in which it is clear of first shift rail (70) and an engaged position in which it engages the first shift rail (70). The second shift finger (104) is formed as a bell crank lever (154), the bell crank lever (154) having a first limb which permanently engages the second shift rail (72) and a second limb, the first shift finger (102) being engagable with the first shift rail (70) or with the second limb of the bell crank lever (154), depending on the angular orientation of the first shift finger (102); and means (134) is provided to move the first shift finger (102) between its engaged and disengaged positions.

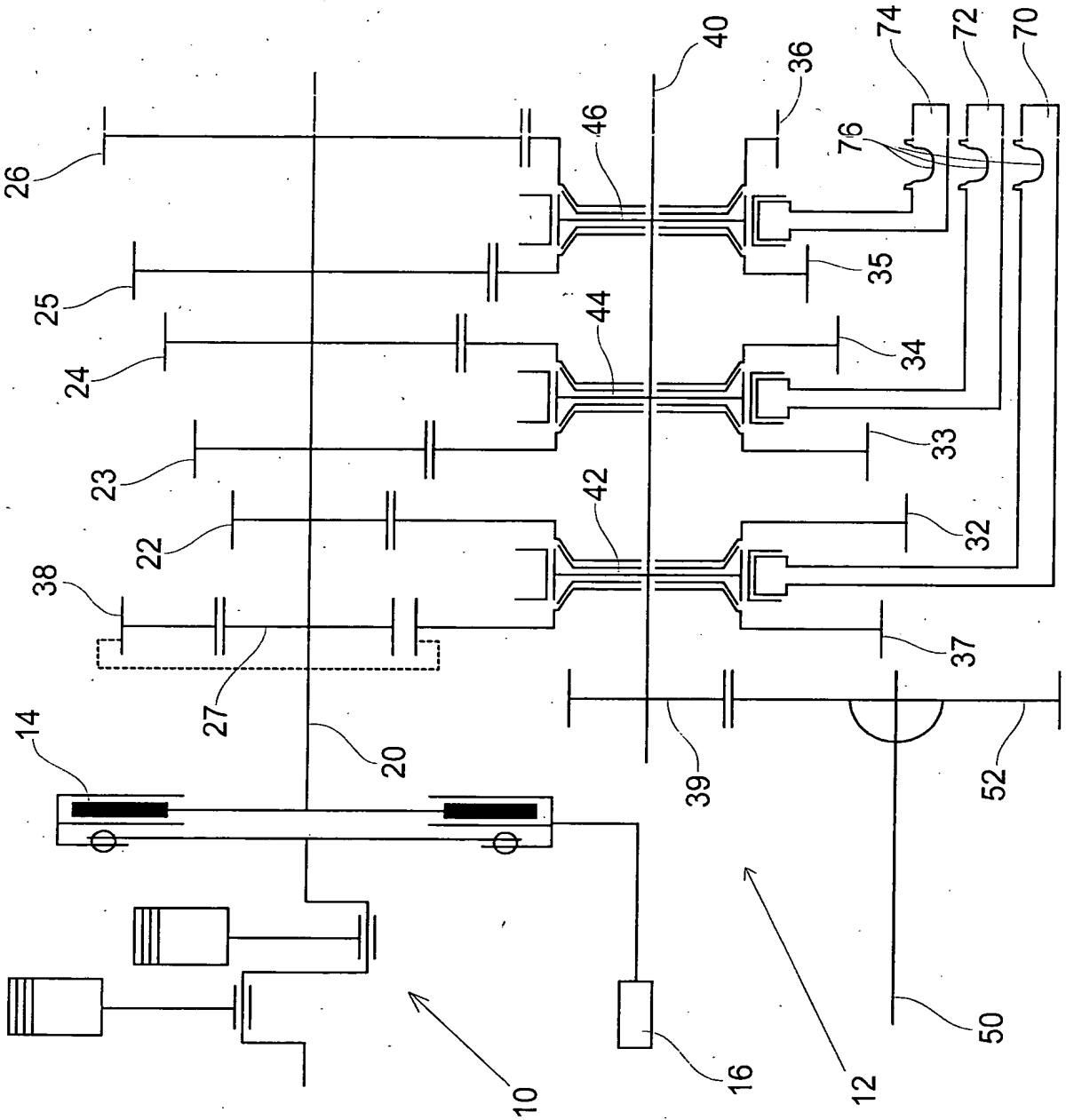
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Fig 1.

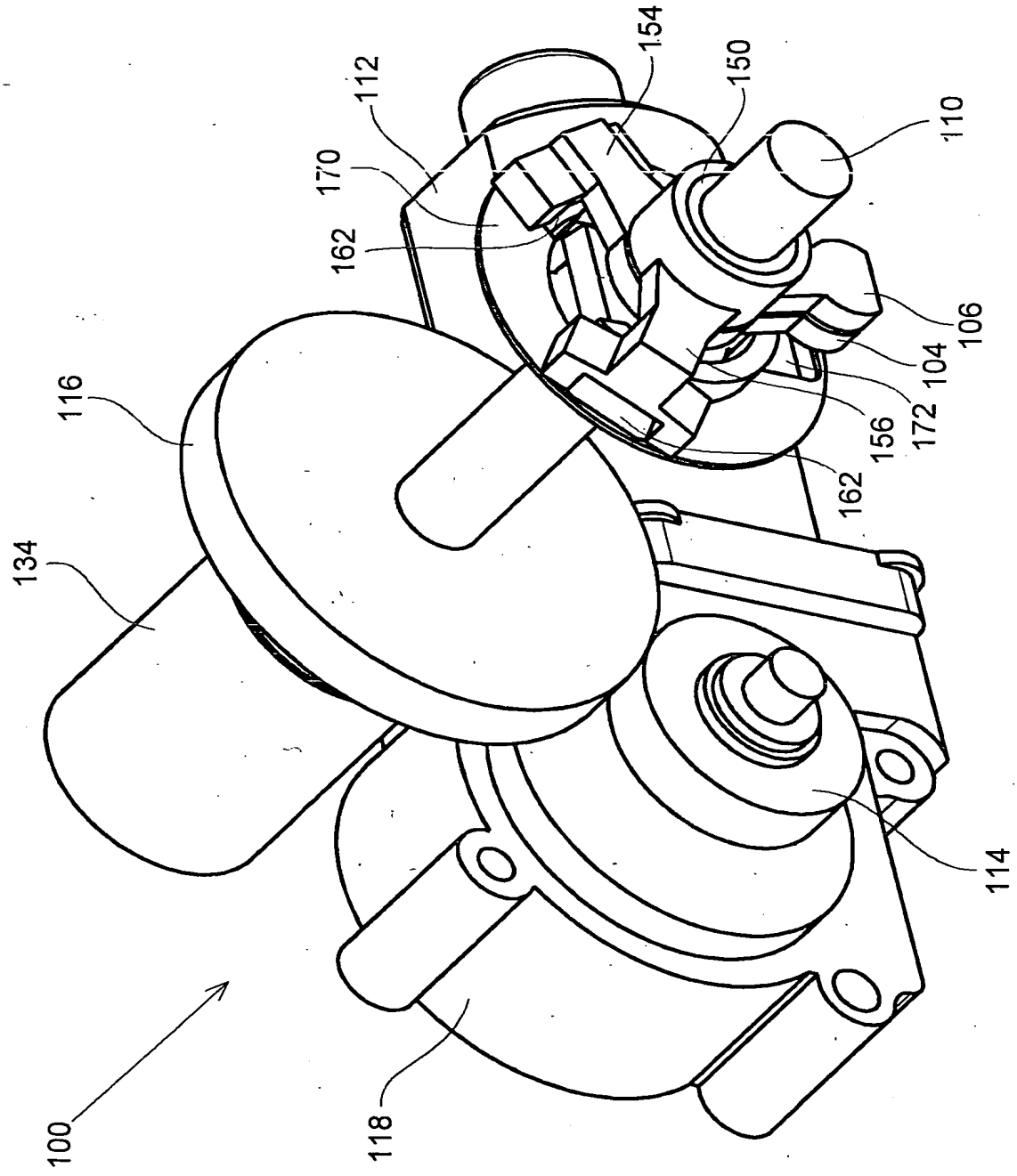

Fig 2.

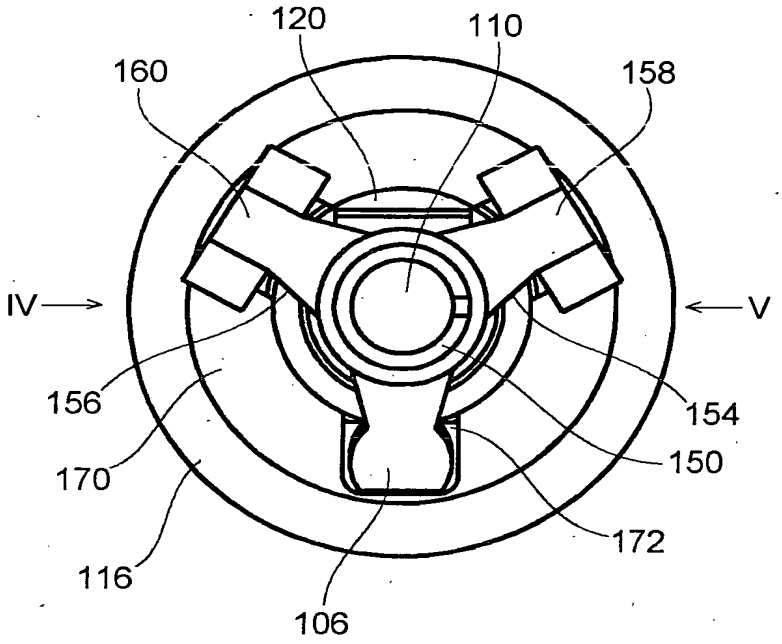

Fig 3

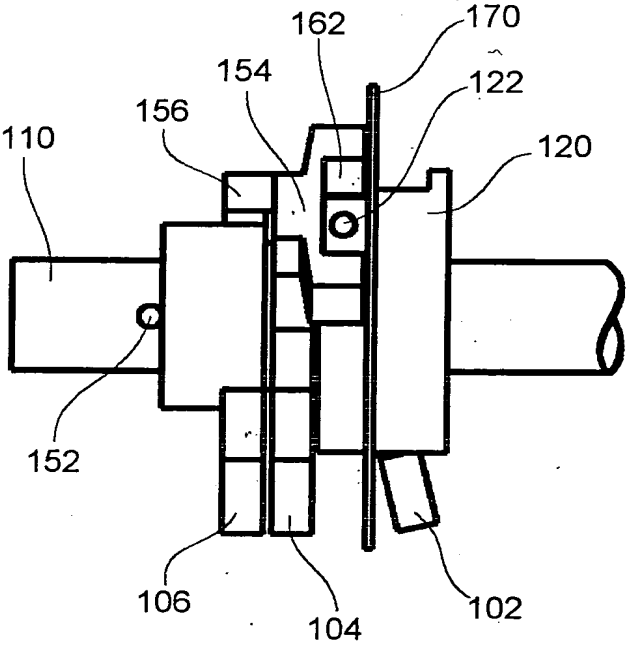

Fig 4.

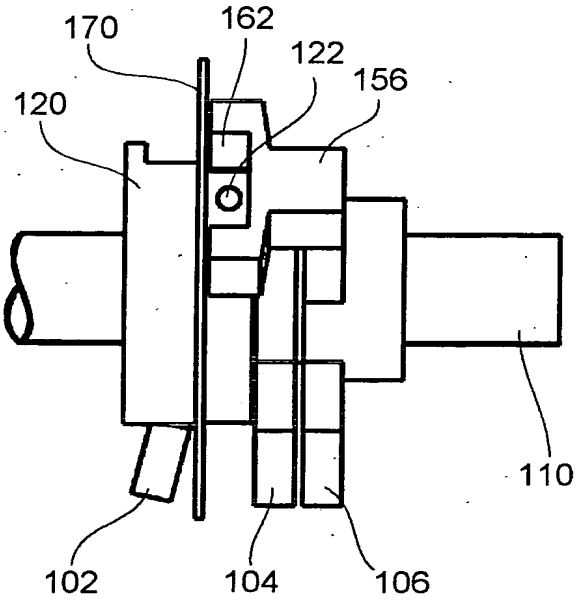

Fig 5.

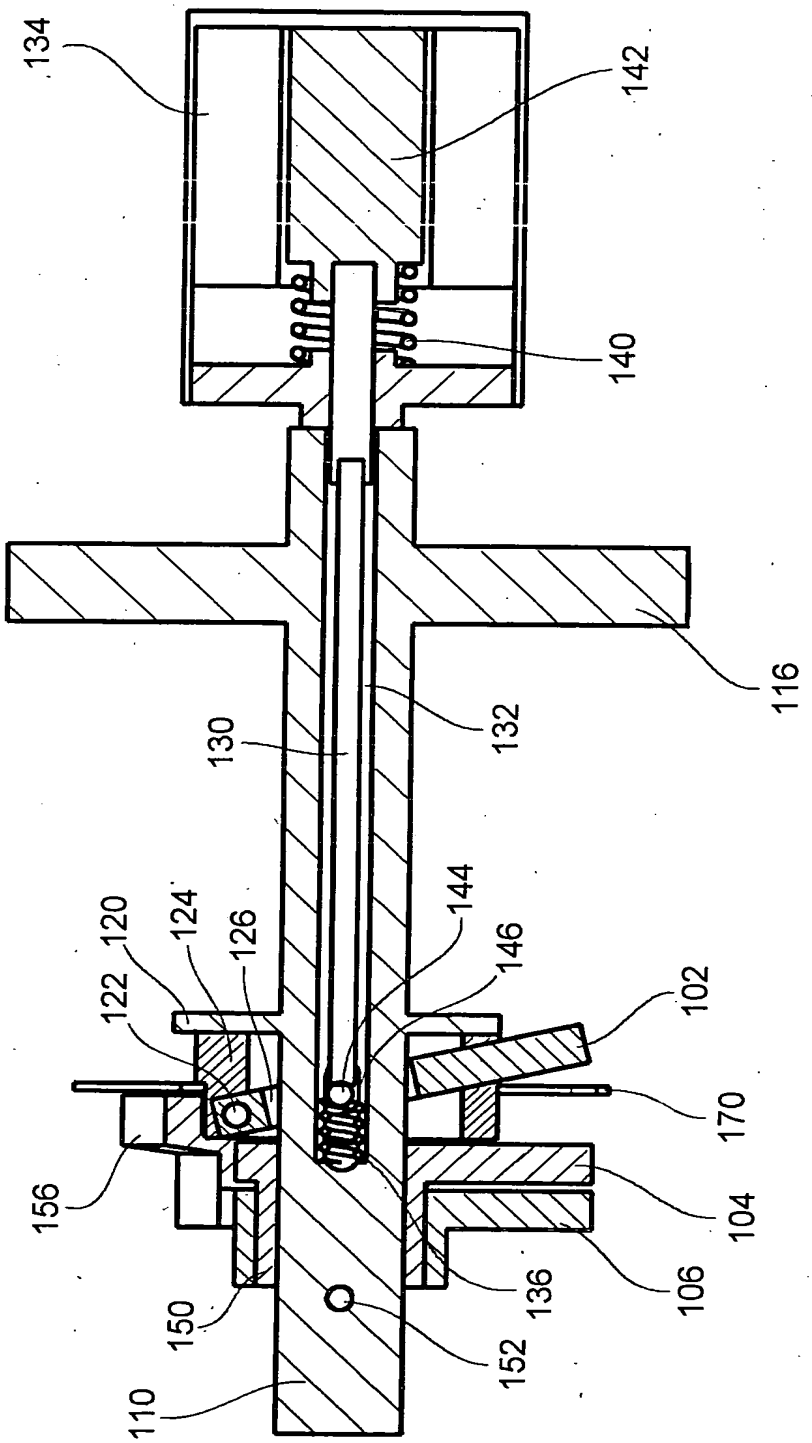
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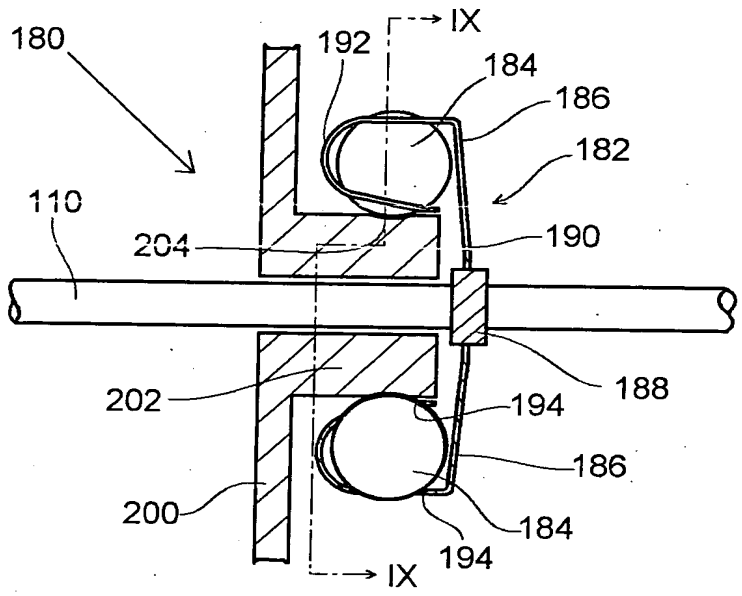
Fig 6.



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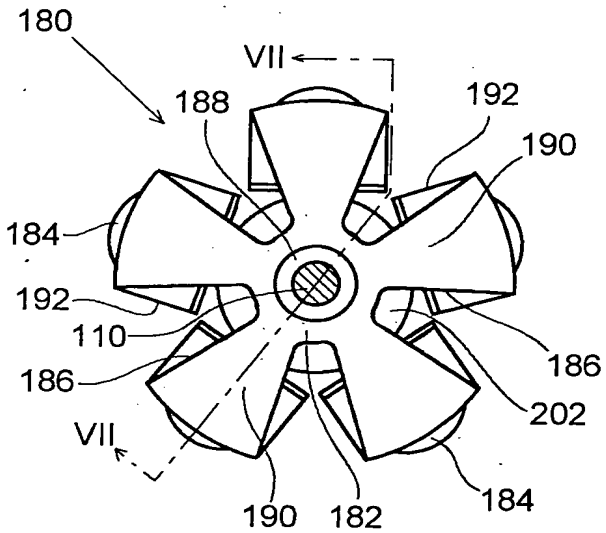

Fig 8.

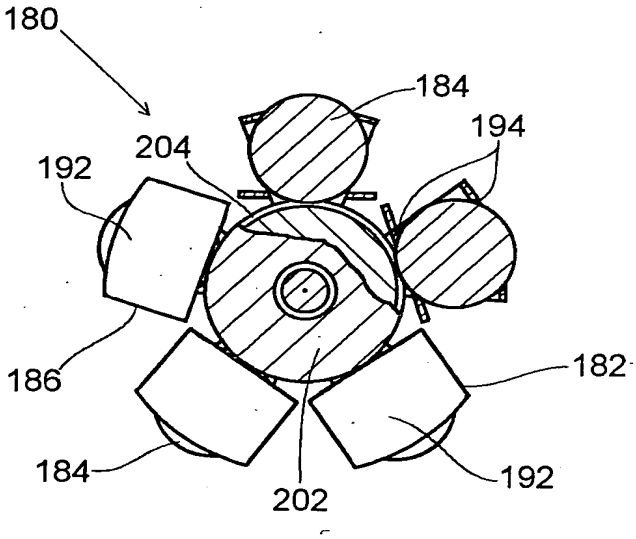

Fig 9.